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ABSTRACTS.

Upper Cretaceous of the Northern Atlantic Coastal Plain. By WM. B. CLARK.

This paper was prepared in coöperation with Messrs. R. M. Baggs and Geo. B. Shattuck who have been Professor Clark's geological assistants for several years. The authors divide the upper Cretaceous into (1) the Matawan formation (including the Crosswicks clays and Hazle sands), (2) the Monmouth formation (including the Mount Laurel sands, the Navesink marls, and the Redbank sands), (3) the Rancocas formation (including the Sewell marls and Vincentown lime sands), (4) the Manasquan formation. Conformably overlying the last and probably of Eocene Age is the Shark River formation. The areal distribution of these five formations was represented upon a large map on the scale of one mile to the inch, which embraced the area between New York Bay and the Potomac River. The variations in distribution and structural relations presented throughout this distance of over 200 miles were discussed as well as the faunal characters of the several formations. The unconformity existing between the lowest of the Cretaceous formations and the Potomac formation below was pointed out as well as the clearly defined unconformity of the Miocene upon the uppermost member of the green sand series; at the same time the evidence for and against unconformity between the Monmouth and Rancocas formations was discussed without a final decision being rendered upon this point, the evidence being somewhat conflicting in this matter. The Matawan-Monmouth formation was held to be equivalent to the Eutaw, Rotten Limestone and Ripley groups of Alabama and the Pamunkey formation equivalent in all probability to all or the greater part of the Lignitic, Buhrstone and Claiborne of the same area, so that the Rancocas, Manasquan and Shark River formations must represent the interval between the Ripley and Lignitic of the Gulf. The first two are regarded as of Cretaceous, the last of Eocene Age. The different Cretaceous formations of the Atlantic coastal plain were shown to be approximately equivalent to the Senonian and Danian of Europe.

Age of the Lower Coals of Henry County, Missouri. By DAVID WHITE.

Under this title was presented a discussion of the evidence derived from extensive collections of fossil plants as to the stage of those coals in other American and European sections. Although the stratigraphic palæobotany of the Pennsylvania–Ohio bituminous series is but very imperfectly known, the indicated position of the basal coals of Henry county is apparently higher than the Mazon Creek stage or Brookville and Clarion coals, and presumably lower than the Middle Kittanning, it being perhaps near the Lower Kittanning in that series. Compared with the plants from the section of the Northern anthracite field the Missouri flora is considered by Mr. White as hardly so recent as the E (“Pittston” or “Big”) vein though probably as late as the D (“Marcy”) vein with which it seems to be nearly synchronous.

Concerning the relations of the Missouri flora to the floras of the Old World, to which forty-two of the forty-four American genera are common, the conclusions are very interesting if, as the author maintains, the occurrence of the same species in the different basins was approximately contemporaneous. The comparative study of the geographical and the vertical distribution of the species from the basal coals of Henry county shows that this flora is probably later than the Middle Coal Measures of Great Britain, the closest alliance being with that found in the “transition series” between the Middle Coal Measures and the Upper Coal Measures, with the flora of which ours has much in common. A similar strikingly intimate relationship, involving a large percentage of identical species, exists between the Henry county flora and that of the Valenciennes series (*Houiller Moyen*) in the Franco-Belgian field. The American flora is clearly not older than the third or upper zone of this series, to which M. Zeiller would also refer our Mazon Creek plants. The correlative conclusions respecting the British and the Franco-Belgian measures are corroborated by the relations of our flora to the plants of the Geislautern beds, which shows that the stage of the Missouri plants is in the upper part, probably near the top of the *Sarrbrücker Schichten* (Westphalian).

The local stratigraphic position of the phytiferous beds of Henry county, the Jordan coal, and another seam about forty-five feet higher, is, as described in the state reports, somewhat peculiar, since these beds lie, at some points, in almost direct contact with the deeply eroded floor of Mississippian rocks. The plants offer therefore criteria by which to approximately fix the date when the early Meso-Carboniferous

inundation reached the vicinity of Clinton, and they mark the close for that district, of the post-Mississippian erosion period, during which the entire Pottsville series, reaching at some points a thickness of two thousand feet or more, and a portion of the Lower Productive Coal Measures were laid down in the Appalachian basin.

*Crater Lake, Oregon.*¹ By J. S. DILLER.

Crater Lake of southern Oregon is deeply set in the hollow base of a large cone upon the summit of the Cascade range. Its rim rises by moderate slopes a thousand feet above the general level of the range, and the descent within to the lake is precipitous. The lake, with an altitude of 6239 feet above the sea, has no outlet. It is approximately circular, with an average diameter of about five miles, and is completely surrounded by cliffs ranging from over 500 to nearly 2000 feet in height. The steep slopes continue beneath the water to a depth of 2000 feet. The great feature of the region is not the lake, but the caldera which it half fills and thus partly conceals but greatly beautifies. The rim has the structure of the peripheral portion of the base of a great volcano. It is composed of lava streams and sheets of volcanic conglomerate radiating from the lake. Sections of the coulées appear upon the inner slope of the rim where their broken ends form cliffs toward the lake, and it is evident that they once converged, forming a large volcano on the site of the lake, from which they issued. In some cases, as for example under Llao Rock, the valleys filled by great flows upon the outer slope of the central volcano are clearly visible in the section afforded by the rim. The earlier lavas of the rim are andesites, and the later ones rhyolites, while basalts, which are also of late eruption, are confined to small adnate cones low down upon the outer slope of the rim. The rim is cut at a number of points by dikes radiating from the lake, and this feature taken in connection with the succession of lavas, and especially the structure of the rim, clearly points to Crater Lake as a great volcanic center. The rim of the lake has been deeply scored by glaciers, but this phenomena is confined wholly to the outer slope. Striæ and moraines are found on the very crest of the rim overlooking the lake. Deep U-shaped canyons extend directly through the rim ending on

¹ Published in the American Journal of Science for March 1897, and in a more popular form in the National Geographic Magazine for February 1897.

the brow of the cliff which rises many hundreds of feet above the lake level. All of these features must have been formed by glaciers descending from the peak represented by the rim. In other words, during the glacial period Crater Lake did not exist, but in its place there towered a great volcanic peak, rivaling Shasta in size, from which emanated the coulees of the rim as well as the glaciers for its striation. The relation of the striæ to the later flows shows that the volcano was yet active in the glacial period. The removal of so great a volcano and the production of the large caldera is due to subsidence. This is shown by the absence of a fragmental rim, such as would have been formed if the material had been removed by an explosion, and also by the action of the final coulée from the volcano. It flowed not only over the outer slope of the rim, but also over the inner slope toward the abyss into which the mountain disappeared. Since this engulfment several smaller piles of volcanic material have been formed by eruptions upon the bottom of the caldera. One of these rises so high as to form an island in the lake, and furnishes an excellent example of a cinder cone and lava field.

Nipissing-Mattawa River, the Outlet of the Nipissing Great Lakes.

By F. B. TAYLOR.

When the waters of lakes Superior, Michigan and Huron were making the Nipissing beach, their outlet was eastward over the Nipissing pass at North Bay, Ontario, to the Ottawa valley. This outlet river is called the Nipissing-Mattawa River and the three upper Great Lakes of that time are called the Nipissing Great Lakes. Mr. G. K. Gilbert visited North Bay in 1887, Professor G. F. Wright in 1892 and the writer explored some of the ground at North Bay in 1893, and more, with a visit to Mattawa, in 1895. Last autumn a canoe trip of six days in fine weather was made from the head of Trout Lake to Mattawa, thus covering the whole length of the Mattawa valley.

The Nipissing beach is well developed at North Bay at an altitude of about 700 feet above sea level. On the present col at North Bay the old outlet bed is somewhat over a mile wide, 30 to 35 feet deep at the maximum and perhaps half that on the average. The average here, however, is not easy to get, for there was an archipelago on the south side, and not much is known as to the number and capacity of the old channels between the islands. The first swift water of the ancient

outlet was at the foot or east end of Trout Lake about twelve miles east of North Bay. The Nipissing beach though faint can be followed to the foot of Trout Lake.

The effects of the flowing current of the ancient outlet river are well marked at several points. The places of several ancient rapids and one cataract were found. The cataract was at the present Talon Chute and the four most notable rapids were, (1) below Turtle Lake, (2) below a lake called Pimisi Bay, (3) at the modern Des Epines Rapids and (4) at Mattawa. The falls were 25 to 30 feet high and the postglacial gorge made by them is very distinct. It is not quite half a mile long, but it is deep and averages only about 300 feet in width. The walls are of red granite and vertical 40 to 100 feet. A thin and highly inclined bed of crystalline limestone passing down into the gorge from the west may have hastened the cutting somewhat. The ancient river was expanded to a lake in the Lake Talon basin, and made faint but distinct shore lines by wave action. One is 20 feet above the present lake and the other ten or twelve feet higher. The mark of the surface level of the river was quite plain at some of the rapids. On the north side at Des Epines rapids this mark is 55 feet above the present river. The channel at that level was between 600 and 700 feet wide and averaged 35 to 40 feet in depth, and the current was strong enough to move gravel and pebbles of small size. This corresponds in a general way with the size of the modern St. Clair River.

Ancient rapids were recognized in three ways. There are several narrow passages that are heavily boulder-paved. They mark the points where moraines cross the channel. At Des Epines and Mattawa the boulders of gneiss and granite are worn and scoured into many curious forms. Many were found with basins or potholes bored in them and a few bored clear through so as to become ring-boulders. At each of these rapids a stream enters just above and furnished a constant supply of gravel, sand and pebbles for the current to roll over and among the boulders. The rapids below Turtle Lake and Pimisi Bay are of the same sort except that the water issued from lakes, and so had no supply of gravel to scour with. The third way of recognizing rapids was by inference indirectly. Such rapids were in narrow defiles or canyons with walls of bare rock and the fact that rapids had existed there was inferred from the observed drop in the surface level of the river above and below. The remains of the ancient Nipissing-Mattawa River agree with the Nipissing beach in indicating that

the Nipissing Great Lakes endured for a relatively long period of time. And so long as it lasted, Niagara had only the discharge of Lake Erie.

A detailed account of the scoured boulders appears in the current (March) number of the *American Journal of Science*.

The Grain of Rocks. By ALFRED C. LANE.

The grain of rocks is dependent on the chemical composition and the causes that produce solidification, cooling, gas diffusion, etc., the general law being, the more rapid the action the finer the grain. The paper discusses the grain from the threefold standpoint of theory, observation upon the Keweenawan rocks, and experiment.

In regard to chemical composition, the augite of the luster-mottled melaphyres shows plainly the empirical law that the less there is of it the finer is its grain, other things being equal.

The following laws of cooling are mathematically applicable to an indefinite sheet :

(A) The case where we consider the adjacent rock symmetrically heated by the sheet can be solved by aid of a solution for the case that the walls are kept at a fixed temperature. For the temperature at any point P of the affected zone $A D$ (the sheet and its contact zone) is the average of the temperatures that two points P_1 and P_2 would have that were at the same distances from the walls of a hypothetical dike $E F$, as broad as the whole zone affected (its walls being kept at a constant temperature) as the point whose temperature is sought is from the two walls of the smaller sheet ; the sum of the temperatures being

$$\frac{\begin{array}{ccccc} A & B & P & C & D \\ \hline & P_1 & & & P_2 \\ \hline E & & & & F \end{array}}$$

taken if said point is within the small dike, the difference if it is outside in the contact zone (time and initial conditions being the same).

(B) Taking the case of a sheet originally of a uniform temperature where the sides of the sheet are kept at a fixed temperature, we can divide the cooling into three periods :

(1) Before the center has cooled appreciably. During this period the rate of cooling is as the square of the distance of the margin, and independent of the size of the sheet otherwise.

The augite of the Keweenawan ophites follows in its grain this law, the average area of cross sections being proportional to the square of the distance from the margin, and independent of the size of flow.

Consolidation in this period may *a priori* be expected to be especially characteristic of effusive and porphyritic rocks.

(2) While the center is cooling down one-fourth of original difference in temperature between sheet and margin. This period is about four times as long as the first.

(3) Thereafter the rate of cooling when given temperature is reached will be independent of the position of a point. Hence the grain will be uniform and the same for all parts of the sheet that consolidate in this period. The solidification will tend to fall into this period for high initial temperatures of the magma and hot walls, compared with the temperature of solidification and broad contact zones. Hence solidification in this period may be taken as typical for abyssal rocks.

Dikes of the Keweenaw in the Huronian show a marginal zone where the grain appears to have been formed in the first period of solidification, and a central belt where the solidification appears to have been in the third period.

Similar phenomena may be reproduced in melted sulphur, and in sugar and water. In the latter case we have phenomena of aqueo-igneous fusion, and the temperature of solidification being comparatively low, there is a strong tendency toward the appearance of the central zone of uniform grain. The tendency to solidify as glass is dependent upon the escape of the water.

If the sides are not kept at a fixed temperature, the sides will cool more slowly than the center, for temperatures half way between the initial temperatures,—a possible explanation lies here for a certain kind of porphyritic facies of granites.

A Study of the Nature, Structure, and Phylogeny of Dæmonelix. By
E. H. BARBOUR.

Additional expeditions to the Dæmonelix region have added new data showing the apparent steps in the phylogeny of this anomalous group.

The simplest expression of Dæmonelix seems to be a fiber found in the sand rock, which shows unmistakable plant structure, and is, in every respect, like the fiber found in all the Dæmonelix series. The author's present belief is that the various forms of the Dæmonelix group result from the aggregation of these simple fibrous, fresh-water seaweeds into variously shaped bunches, clusters, and spirals.

Ascending to higher beds one comes next to *Dæmonelix* "cakes," which are about the size of common camp griddle-cakes. So far as can be determined by the eye or the microscope they are nothing more nor less than colonies, or aggregations of *Dæmonelix* fibers. Vertical range twenty-five feet.

Next above the "cakes" come the *Dæmonelix* "balls," which resemble in size and shape the old New England codfish ball. These are but aggregations or bunches of *Dæmonelix* fibers. Vertical range about twenty-five feet.

Next come slender forms of nearly vertical and somewhat spiral habit, called *Dæmonelix* "cigars." The weathered and broken ends of these occur in immense abundance. They are about the size and length of an ordinary walking stick. These, too, are but aggregations of the simple *Dæmonelix* fiber. Though practically confined to a range of twenty nor more feet they occur, in decreasing numbers, almost through the upper *Dæmonelix* beds.

The forms encountered next are frail and slender, scarcely thicker than the wrist, yet positively spiral and vertical in habit. They are viewed as the immediate progenitors of *Dæmonelix* regular. They are but aggregations of the primitive *Dæmonelix* fiber. Vertical range scarcely twenty feet.

Above all, comes the "Devil's Corkscrew," the first forms of which are smaller, more regular, and more mathematically exact than are the larger and strangely modified forms characteristic of the topmost beds. Some are free spirals, some are fixed about an axis, some have no transverse trunk, others have one, two, or three; others, called "twin screws," have, in each case, a large screw and transverse trunk, ending in a smaller reversed screw and trunk. These are thought to be the first complete specimens of *Dæmonelix*. Continued study makes it only the more apparent that these magnificent screws are but spiral aggregations of the simple *Dæmonelix* fiber first encountered.

More than one hundred micro-sections have been cut from all parts of all forms. Without exception all show precisely the same simple, cellular, non-vascular structure, to be likened only to seaweed. Numerous photomicrographs of these have been made and are ready for publication.

RECENT PUBLICATIONS.

—American Museum Natural History.—Bull., Vol. VIII, 327 pp. New York, 1896.